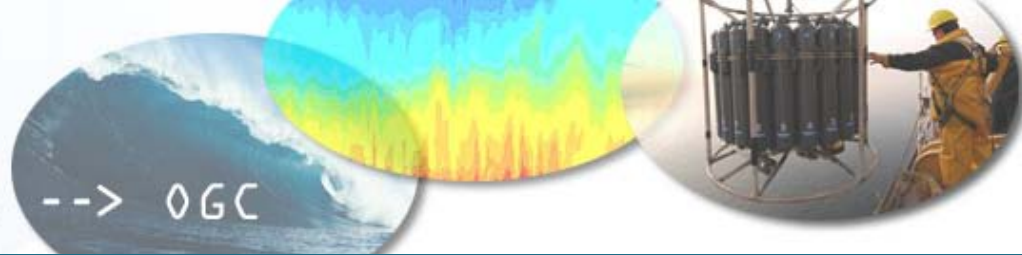




QARTOD --> OGC



Implementing QA/QC Standards for In Situ Ocean Sensors Using OGC-Sensor Web Enablement

a.k.a. QARTOD to OGC
a.k.a. Q2O

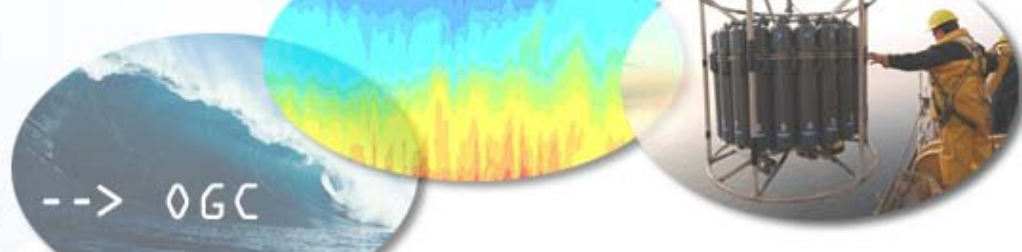


Project Status Brief to NOAA IOOS Program

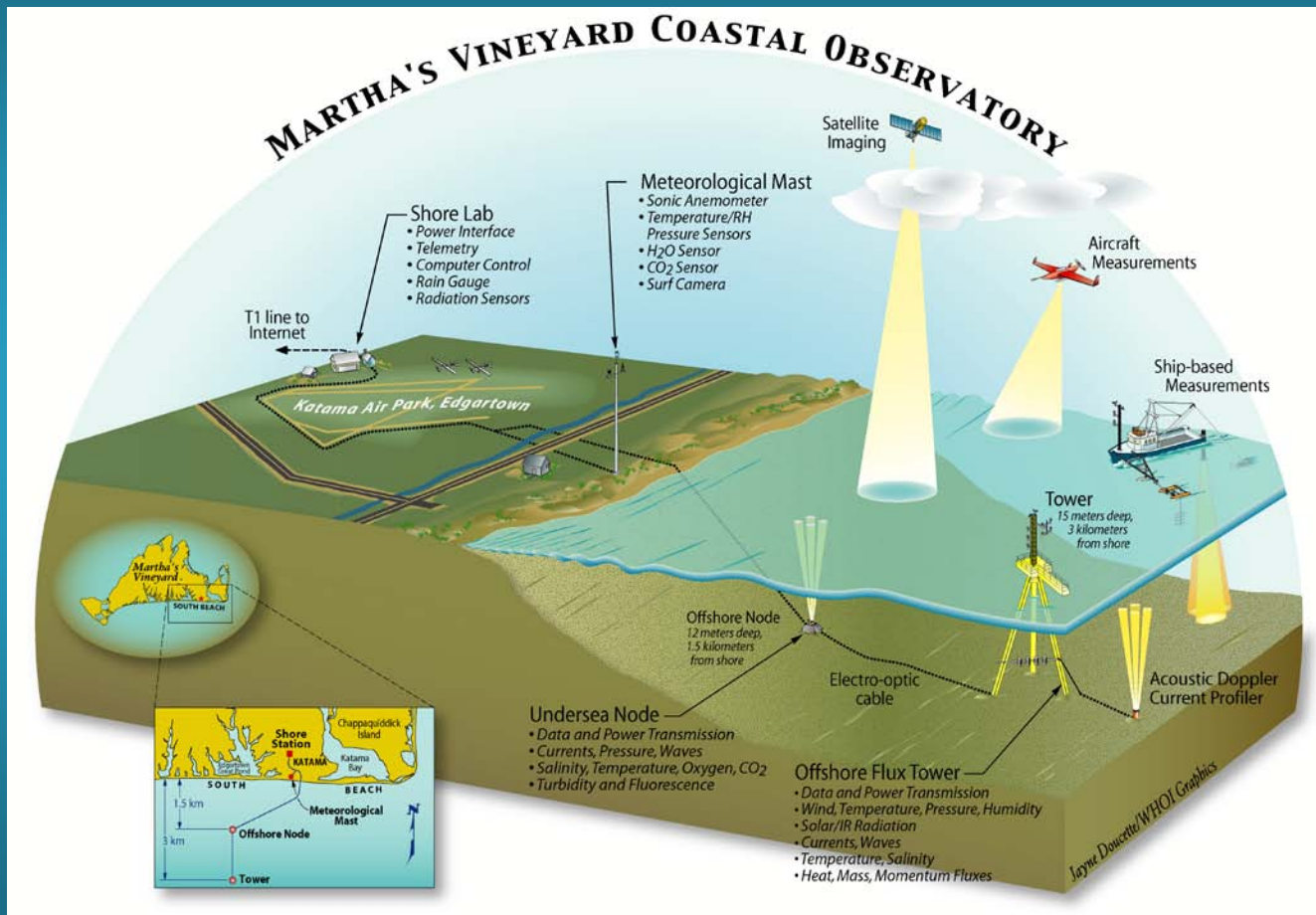
January 13, 2009

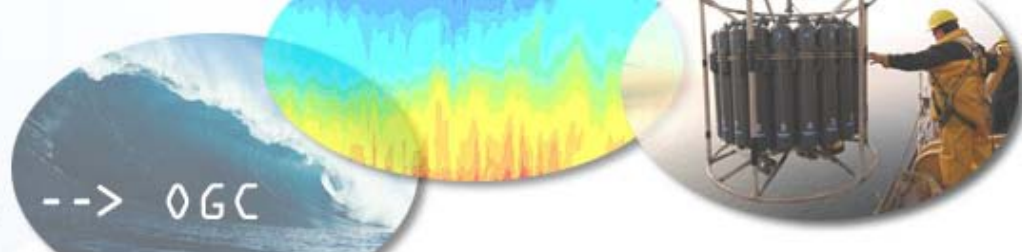
Updated August 7, 2009





Once upon a time





Community activities were addressing individual parts...

MMI Workshop '06

<MMI />

P R E S E N T S

Sensor Metadata Interoperability A Workshop in Two Tracks

<http://marinemetadata.org/workshop06>

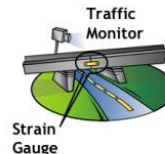
Portland, Maine
19-20 October 2006

For details, see the web site
or
John Graybeal: graybeal@p
Monterey Bay Aquarium Research
Direct Phone: 831-2



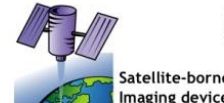
Sensor Web Enablement (SWE)

The OGC's Sensor Web Enablement (SWE) standards enable developers to make all types of sensors, transducers and sensor data repositories discoverable, accessible and useable via the Web.



Health Monitor

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OpenGIS® Standards

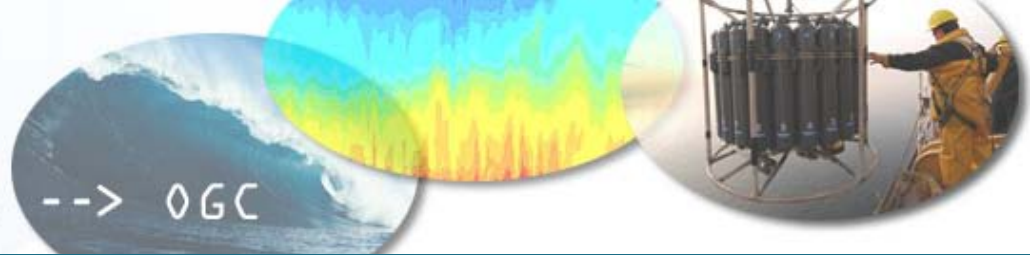
The main adopted or pending OpenGIS Standards in the SWE framework include:

- **Observations & Measurements (O&M)** - The general models and XML encodings for observations and measurements.
- **Sensor Model Language (SensorML)** - standard models and XML Schema for describing the processes within sensor and observation processing systems.
- **Transducer Markup Language (TML)** - Conceptual model and XML encoding for supporting real-time streaming observations and tasking commands from and to sensor systems.
- **Sensor Observation Service (SOS)** - Open interface for a web service to obtain observations and sensor and platform descriptions from one or more sensors.
- **Sensor Planning Service (SPS)** - An open interface for a web service by which a client can 1) determine the feasibility of collecting data from one or more sensors or models and 2) submit collection requests.





QARTOD --> OGC



Bringing together community members as Q2O Team

Janet Fredericks - WHOI, MVCO, QARTOD

Mike Botts - UAH, OGC SWE

Julie Bosch - NOAA, MMI, IOOS DMAC, QARTOD

Sara Haines - SECOORA, NCCOOS

Philip Bogden - GoMOOS, IOOS DMAC, SURA, MMI, OOSTethys

Tony Cook - UAH, OGC SWE, OIE

Eric Bridger - GoMOOS, OOSTethys

Luis Bermudez - SURA, OOSTethys, OpenIOOS, MMI, OIE

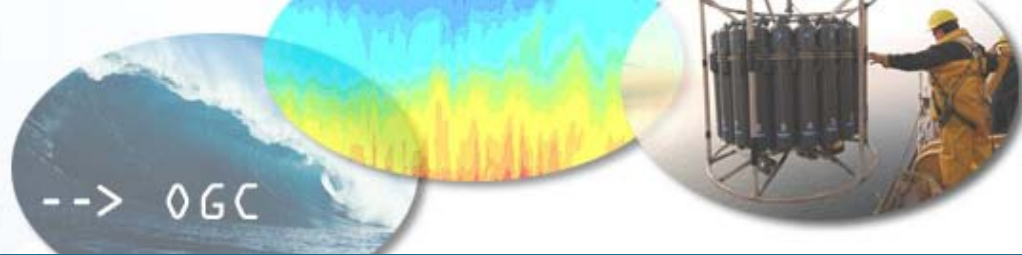
Vembu Subramanian - COMPS

Grace Cartwright - VIMS

Brenda Babin - LUMCON



QARTOD --> OGC



What is Q2O?

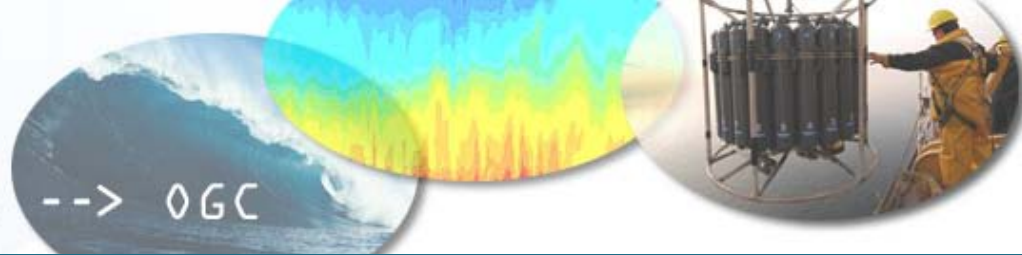
Funded by NOAA CSC/IOOS (January 2008 – December 2010)

Deliverables:

- Implement the QARTOD recommendations into the OGC Sensor Web Enablement framework providing SensorML profiles for QARTOD tests
- Documenting results by providing a tutorial
- Test the deliverables by implementing services at participating data centers

Methodology:

- Bring together IT specialists with domain experts (for waves, in situ currents, CTD observations and Dissolved Oxygen)
- Partner with community building projects such as OOSTethys and MMI



What does that mean?

What do we have (know) to start with?

- A sensor (wave buoy or ADCP) with certain characteristics
- A sensor history
- QA info associated with a sensor
- Deployment characteristics
- Methods to process the data
- QC Tests to apply to the data
- ...
- ...

What information can we provide to data users via systems (OOSTethys, OpenIOOS)?

- What sensors we have available as a service
- Description of the sensor
- Description of where / how / when it is deployed
- List of the processing methods used on the data
- List of the QC tests applied
- The criteria used in the QC tests
- The results of the QC tests
- The data
- ...

How and with What do we convey that information?

Get Capabilities

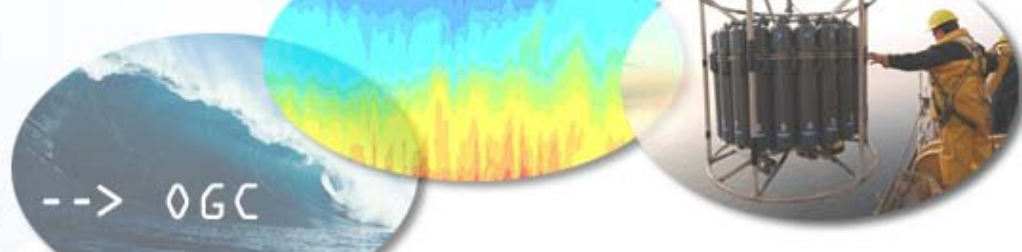
- lists available data
- uses SOS, Observation Offering

Describe Sensor

- Provides sensor and deployment characteristics and processing methods
- Uses SensorML

Get Observation

- Provides the data, test results and points to file with processing/test info
- Uses O&M



What had/has to be done by Q2O?

- Engage QARTOD experts
- Gather QARTOD information
 - identify recommendations
- Define Processes
 - input / output / criteria
- Develop vocabularies
- Convey as SWE instances
- Test implementation
- Develop Guidance
- Applied by OOS implementers

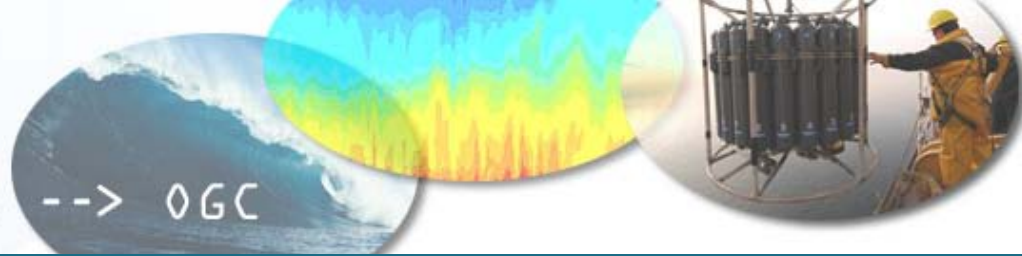
QARTOD	CDIP	FRF	NDBC	NOBSKA	NORTEK	RDI	SONTEK
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QARTOD Quality Control Tests : Waves

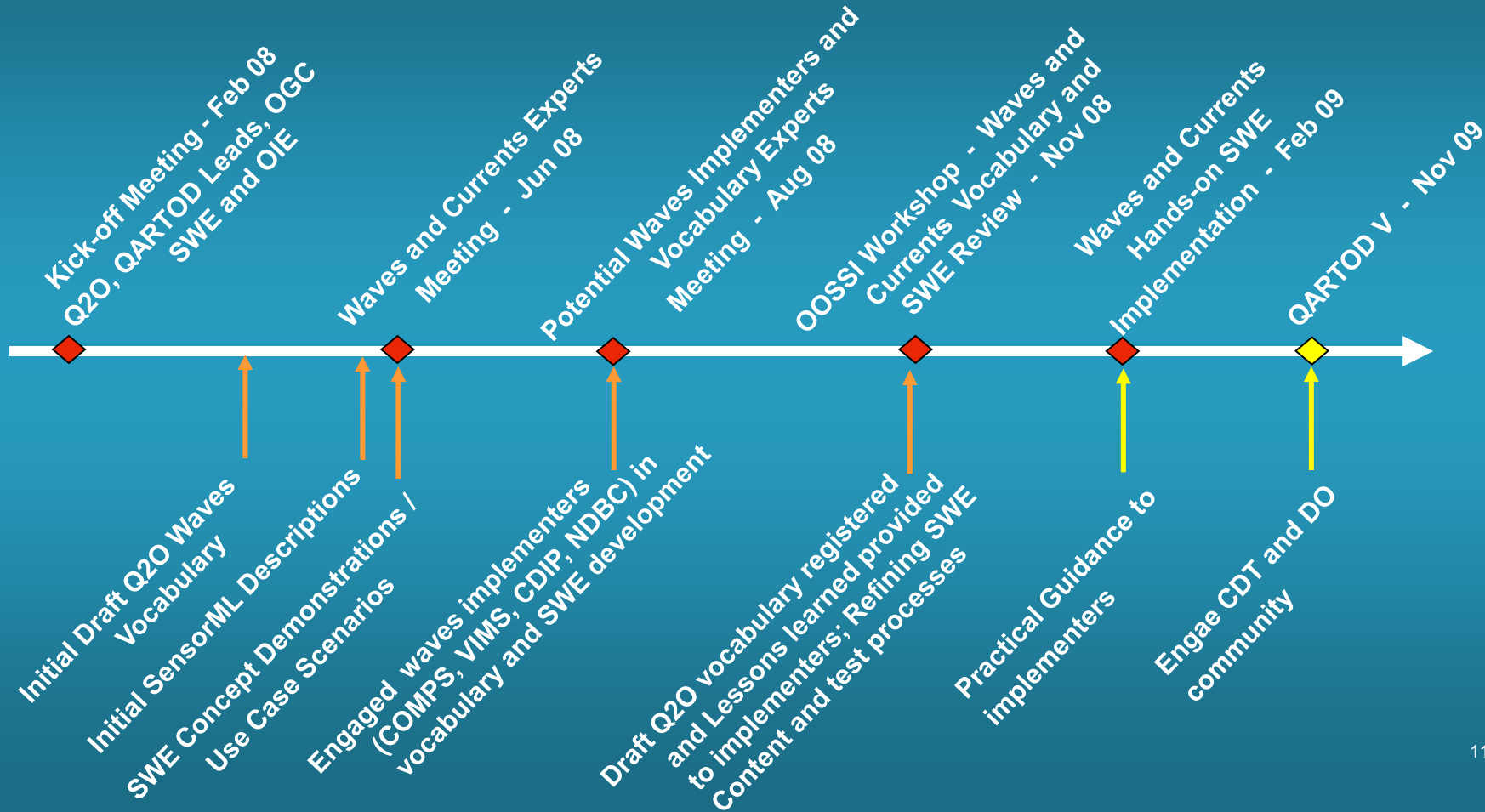
The participants in this effort (shown on the table tabs) propose that the following required tests be performed on wave data to meet minimum IOOS quality control standards. In addition, there are a number of recommended tests.

Note: All tests listed are for open ocean waves.

TIME SERIES (Raw Calibrated Data)				
Category	Criteria	Order	Flag	Action
Data Gaps	Consecutive N missing data. Maximum number of missing data.	1	Soft	N is user defined. Include in % count.
Spikes	User defined Points >= M*std with P iterations	2	Soft	Interpolate/extrapolate up to N points. N is user defined. M can be user defined, recommended M=4. Include in % count.
Range test	Location, instrument defined.	2	1. Soft 2. Hard	Max/min user defined. 1. Interpolate/extrapolate up to n points. N is user defined. Include in % count. 2. Instrument spec exceeded, reject.
Mean shift (segments)	A mean shift "P" occurs in this time series.	3	Hard	Reject entire record. P is user defined.
Acceleration test	User defined (a>M*g)	3	Soft	Recommended M<=1/2. Interpolate/extrapolate up to N contiguous points. N is user defined. Include in % count.
Mean test, variance test	User defined, location dependent	4	1. Soft 2. Hard	1. Flag unexpected values. 2. Reject unreasonable values.
Percent points good	Check for M% good data (based on above 6 criteria)	5	Hard	Recommended M>=90%
SPECTRAL VALUES				
Category	Criteria	Order	Flag	Action
NON-DIRECTIONAL:				
Operational frequency range test	*defined by the environment and instrument	1	1. Soft 2. Hard	1. Max/min user defined. 2. Instrument spec exceeded, reject.
DIRECTIONAL:				
Incident low frequency energy direction	Location defined	1	Soft	User defined



Some Q20 activities to date ...





The details...

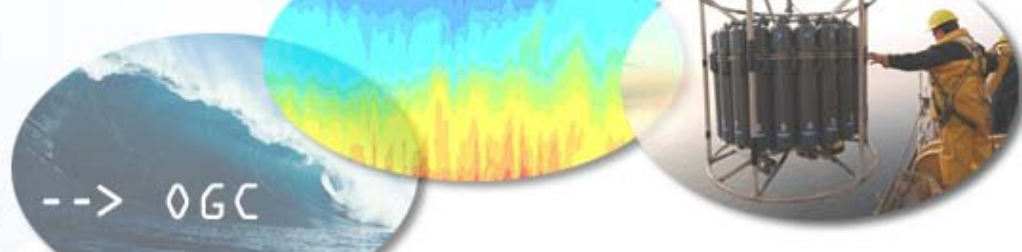
Take QARTOD tests and flags and code them into OGC/SWE instances.

Each test is defined as a process that is described with input and output

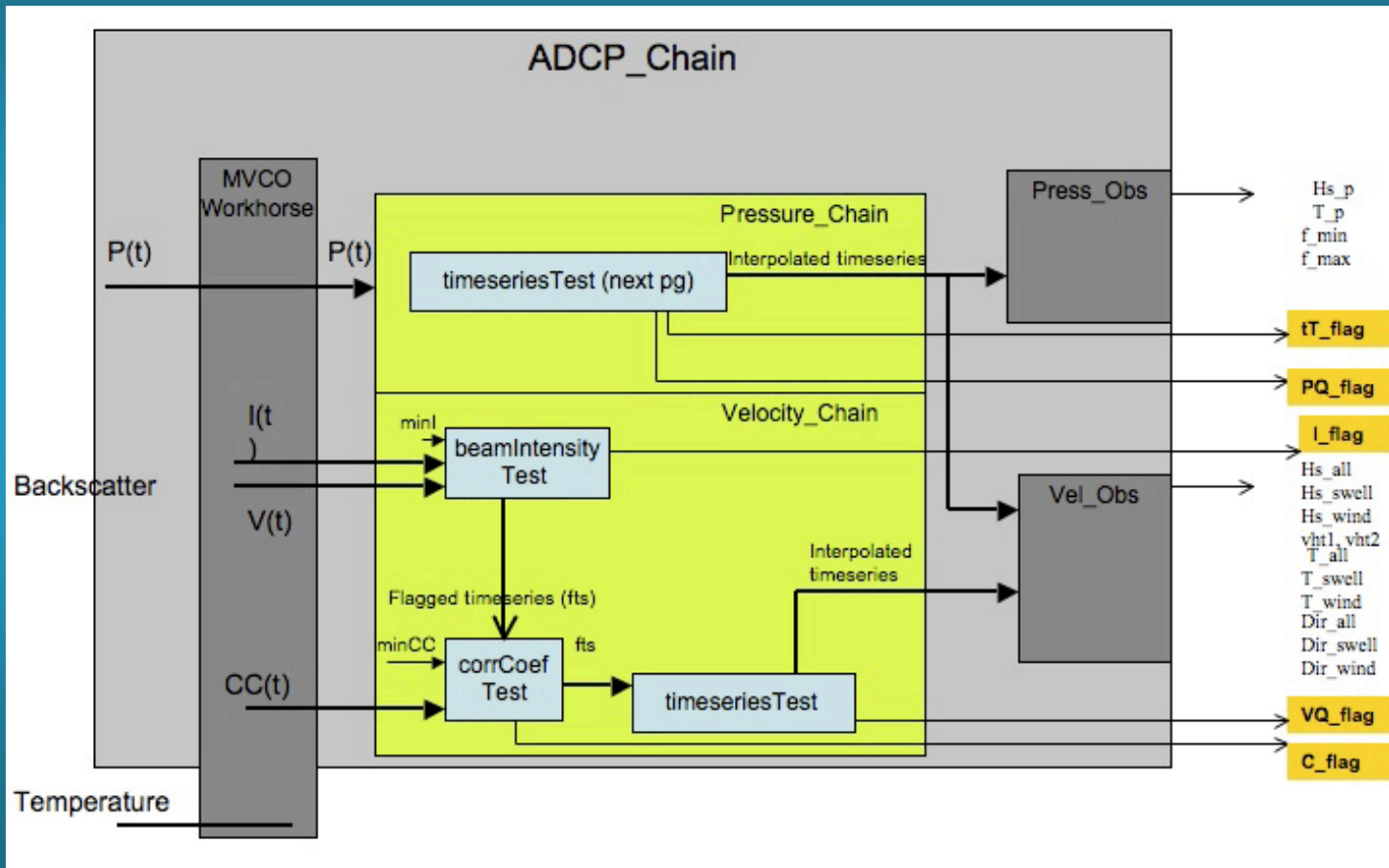
E.g.,

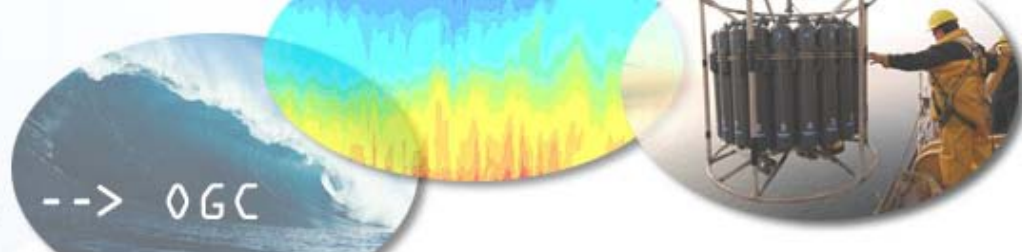
RangeTest has inputs (min, max) and outputs test results (flagged data)

SpikeTest has inputs (tolerance, number of iterations)



The details... *defining processes*





The details... *developing vocabularies*

TIME SERIES (Raw Calibrated Data)				
Category	Criteria	Order	Flag	Action
Acceleration test	User defined ($a > M \cdot g$)	3	Soft	Recommended $M \leq 1/2$. Interpolate/extrapolate up to N contiguous points. N is user defined. Include in % count.
Mean test, variance test	User defined, location dependent	4	1. Soft 2. Hard	1. Flag unexpected values. 2. Reject unreasonable values.



=== Tests and Criteria ===

"ID", "Long Name", "Short Name", "Definition", "Symbol", "Reference", "Figure", "Approval", "Relationship", "Equation", "[Notes]"

====

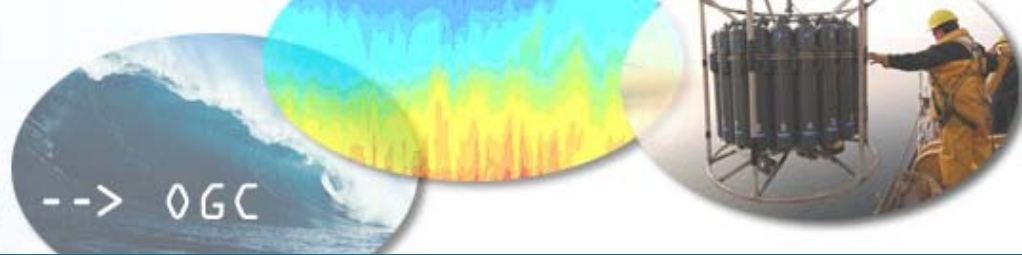
"urn:__:Q2O:test:accelerationTest", "Acceleration Test", "", "The second derivative for each point of the time series of vertical surface displacement is a computed or direct measure of acceleration. The acceleration measurement is tested it against natural limits, approximated as $M \cdot g$.", "", "urn:__:Q2O:ref:qartod_waves_2007", "", "", "urn:__:Q2O:criteria:maximumAccelerationFactor", "", "[Reworded from reference to make it more general for other applications besides waves.]"



<http://mmisw.org/ont/q2o/20081118T031715/qcCategory/accelerationTest>



QARTOD --> OGC



The details... *on the Q2O Project website*

<http://q2o.who.edu>

- materials available to public
- account access (working materials)

A screenshot of the Q2O Project website. The top navigation bar includes links: Home, Overview, About Us, Activities, Meeting Archives, Events, Related Links, and Contact. Below the navigation bar is a search box with a 'Search' button. On the left side, there is an 'Administer' section with a 'Recent posts' link. The main content area is titled 'Deliverables' and contains a paragraph stating: 'This page will contain draft or final documents for the review of the community at-large. It will include a comments section and versioning of each document. Each document will be in a format that is searchable from this site. Please stay tuned!'. Below this paragraph is a list of deliverables:

1. MMI Registered Vocabularies (March 2009)
 - Parameters
 - Tests
 - Flags
 - Bibliography of References used in main vocabulary
2. MVCO ADCP SWE 2.1-Version 2.1 of the SOS for Martha's Vineyard Coastal Observatory. This SOS includes detailed SensorML descriptions of the Quality Control processing that was used to test the raw data.
3. WAVES DEMONSTRATION DICTIONARY
 - MVCO Waves Terms DRAFT
 - MMI Registered MVCO Tests EXAMPLE (not available)
4. IEEE-OCEANS 09 - Bremen, Germany submitted paper

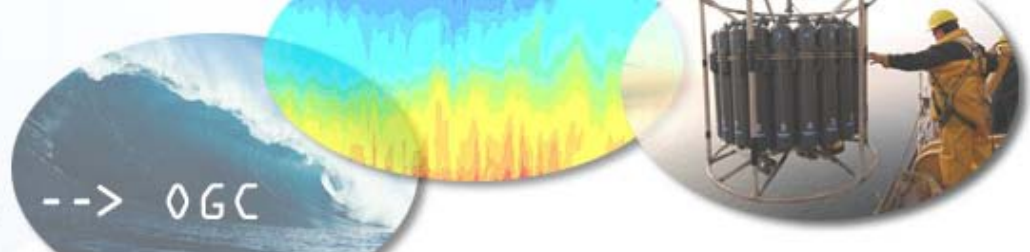


Status...

- Draft waves vocabulary registered at MMI
- Draft MVCO waves implementation
- Lessons learned
 - vocabulary development
 - generation and registration of vocabulary/ontology
 - SWE process chains, parameters, components,...
- Beginning of Guidance document and example files
- Waves implementers signed on (COMPS and VIMS)
- Working with manufacturer to define system
- Identifying “gaps” needed input from QARTOD V



QARTOD --> OGC



What's next?

Q2O – get offerings online; complete tutorial; continue with QARTOD currents, CTD and DO. *Demonstrate computation of waves parameters from triplet processing*

IOOS DIF Coordination Ingest SWE observations with QA/QC descriptions and flags; evaluate and apply additional tests; document in SWE offerings?

OOSTethys into OpenIOOS - utilize QA/QC flags

SUGGESTIONS??